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Reg No.:_____ Name:_____

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**

FIFTH SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2017

**Course Code: CH305**

**Course Name: CHEMICAL REACTION ENGINEERING-I (CH)**

Max. Marks: 100 Duration: 3 Hours

## PART A

***Answer any two full questions, each carries 15 marks.*** Marks

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|---|---|---|---|
| 1 | a) | Define Reaction Rate constant, order and molecularity. | (4) |
| | b) | Derive the temperature dependency of rate constant using collision theory. | (6 ) |
| | c) | The pyrolysis of methane proceeds with an activation energy of about 300KJ/mol. How much faster is the decomposition at 650$^o$C than at 500$^o$C. | (5) |
| 2 | a) | What are the types of mechanism involved in the progress of non elementary reactions and describe the types of intermediates formed? | (6) |
| | b) | Device a mechanism for the reaction $H_2 + Br_2 \longrightarrow 2HBr$ . Evolve a rate equation from the suggested mechanism. | (6) |
| | c) | State and explain pseudo steady state hypothesis. | (3) |
| 3 | a) | Explain Arrhenius equation for temperature dependency of rate constant and how it is substantiated by thermodynamic principles. | (4) |
| | b) | Explain with a neat figure, the principle, operation procedure, application, advantages and disadvantages of any two industrial reactor. | (6) |
| | c) | Explain with an example the steps involved in free radical polymerization. | (5) |

## PART B

***Answer any two full questions, each carries 15 marks.***

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|---|---|---|---|
| 4 | a) | Derive the design equation for steady state plug flow reactor and explain the terms. | (5) |
| | b) | The first order reversible liquid reaction Areversibly giving R, $C_{A0}$= 0.5 mol/l, $C_{R0}$=0 takes place in a batch reactor. After 8 mins, the conversion of A is 33.3%, while the equilibrium conversion is 66.7%. Find the rate equation for this reaction. | (5) |
| | c) | Liquid A decomposes by first order kinetics and in a batch reactor. 50% of A is converted in a 5 min run. How much longer would it take to reach 75% conversion. | (5) |
| 5 | a) | Write short notes on Integral fixed bed reactor and recirculating transport reactor | (6) |
| | b) | Find the first order rate constant for the disappearance of A in the gas reaction 2A giving R, if on holding the pressure constant, the volume of the reaction mixture starting with 80% A, decreases by 20% in 3 minutes. | (6) |
| | c) | Explain the method of initial rates to find the kinetics of elementary reactions | (3) |
| 6 | a) | Derive the performance equation of isothermal batch reactor. | (5) |

b) An aqueous feed of X and Y(400 l/min, 100 mmol X/lit, 200 m mol Y/lit) is to be converted to product in a MFR. The kinetics of the reaction is represented by $X + Y \longrightarrow R$, $-r_x = 200\ C_X C_Y$ mol/lit min. Find the volume of reactor for 99.9% conversion. (7)

c) Describe the principle and working of stirred contain solid reactor (3)

## PART C

***Answer any two full questions, each carries 20 marks.***

7 a) An aqueous reaction $2A \longrightarrow$ products with known kinetics $-r_A = 500\ C_A^2$ mol/ lit min is to take place in an experimental tubular reactor under plug flow conditions. Volume of reactor V=0.1 litre. Volumetric flow rate = 0.05 lit/min. Concentration of reactant $C_{A0}$ in the feed = 0.01 mol/lit. (10)

i) what fractional conversion of reactant can be expected?

ii) For the same conversion as in part i, what size of MFR is needed?

iii) What conversion can be expected in a MFR equal in size to PFR?

b) Explain maximization of rectangles design procedure for determining the best arrangement of a set of reactors for n>1 and n<1. (3)

c) A liquid reactant stream 1 mol/lit passes through two mixed flow reactors in series. The concentration of A in the exit of the first reactor is 0.5 mol/litre. Find the concentration in the exit of the second reactor. The reaction is second order with respect to A and volume of second reactor is twice the volume of first reactor. (7)

8 a) Derive the performance equation of a recycle reactor. (8)

b) Explain optimum recycle ratio, autocatalytic reactions. (4)

c) For a unimolecular type first order series reaction $A \rightarrow R \rightarrow S$, derive the equations for $C_A$, $C_R$, $C_S$, $C_{Rmax}$ and $t_{max.}$ (8)

9 a) Derive Michaelis-Menton kinetic equation for the enzyme catalysed reaction $A \rightarrow R$. (8)

b) Describe the kinetics of inhibition of enzyme reactions by a foreign substance. (6)

c) Write short notes on i) reactive distillation ii) membrane kinetics. (6)

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